Advances in ISOL technology at IGISOL

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The IGISOL facility [1] at the Department of Physics of the University of Jyväskylä (JYFL) is delivering radioactive beams of short-lived exotic nuclei, in particular the neutron-rich isotopes from fission reaction. These nuclei are studied with the nuclear and collinear laser spectroscopy methods. In order to obtain a meaningful increase, in comparison to a standard level, of precision and sensitivity of such studies an improvement of the radioactive beam quality is necessary. This improvement will be achieved due to a radioactive beam handling which consists of three steps: beam cooling, bunching and (isobaric) purification. The latter means a possibility of obtaining a pure monoisotopic beam. Beam handling may be done with an aid of ion traps, in particular of RF and Penning type.

Cooling and bunching are performed with the use of an RFQ cooler/buncher [2]. It is essentially a classical RFQ mass filter filled in with a buffer gas (usually helium). There, an oscillating RF-field is confining the beam axially. At the same time, beam particles are thermalized by collisions with buffer gas. An outcome of this process is a substantial decrease of both transverse emittance and energy spread. The RFQ cooler/buncher was built at JYFL and works well several months already. First successful applications were on the collinear laser spectroscopy where large enhancement on sensitivity was achieved.

The isobaric purification will be made by a Penning trap [3] placed after the RF-cooler. It uses mass-selective buffer gas cooling technique. The latter needs creating a radiofrequency quadrupole field and presence of the buffer gas. The RF-frequency is chosen so that it is equal to the cyclotron frequency of the ions of interest, which are usually mixed with other, contaminating ions. The joint action of the RF-field and the buffer gas is cooling and centering the ions of interest on the trap axis, whereas contaminants are not centered. The ions of interest are then ejected through a small hole in the endcap of the trap. This process can have a high mass resolving power, of the order of 10^5, which permits to reject even isobaric contaminants. This trap is being assembled and tested now. Major part of related equipment, including B=7 T superconducting magnet, exists already.

This contribution describes the current status of the ion trap upgrade of the IGISOL facility and its future prospects. The latter comprise, apart from the experiments mentioned above, also precise nuclear mass measurements and nuclear spectroscopy in the Penning trap interior.

[1] P. Dendooven, Nuclear Instrum. and Methods **B126**, 182 (1997).
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[3] J. Szerypo *et al.*, JYFL Annual Report 1999, 19.